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VIA COURIER
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CONFIRMATION VIA FACSIMILE

Re: Article 34 Response to the International Search Report of the International Searching Authority in PCT Application of STERIS INC.
For: **ACTIVATED VAPOR TREATMENT FOR NEUTRALIZING WARFARE AGENTS**
Appln. No. **PCT/US04/12744**
Filed: April 23, 2004
Our Reference: MEDZ 201324 PCT

Dear Sirs:

This letter is in response to the Partial International Search Report mailed 24 May 2005, and is accompanied by the prescribed fees set out in the Invitation to Correct Defects, mailed 1 June 2005, for the Chapter II demand, which was faxed to the EPO on 21 February 2005. Applicants request a **Full Written Opinion**.

Substitute pages 3, 3A, and 15-23 are attached in triplicate. These pages amend the claims in the following respects: Claim 1 has been amended to incorporate subject matter of claims 4, 5, and 8. Claims 5 and 8 are now cancelled. Claims 6-7 and 9-53 (including two claims numbered 52) are renumbered as claims 5-52. Pages 3 and 3A of the specification have been amended to reflect these changes. The attached sheet shows the changes to claim 1 which are made by this amendment.

Applicants do not wish to have claims 30-53 examined at the PCT stage.

Claim 1 now calls for a method of deactivating a pathogenic chemical agent which includes subjecting the agent to a peroxide in vapor form and a nitrogen containing

compound in the form of a gas. The ratio of the peroxide to the nitrogen containing compound is between 1:1 and 1:0.0001. The cited references do not disclose such a method.

WO 03/090875 to STERIS is an intervening reference since it was published after the priority date of the present application. Moreover, it does not disclose a ratio of a peroxide to a nitrogen containing compound of between 1:1 and 1:0.0001.

The Searcher raised the combination of US 5,998,691 to Abel, et al. and U.S. Patent No. 6,245,957 to Wagner for claims 4 and 5, as originally filed. Abel discloses treating chemical warfare agents with solvated metal ions formed by reaction of a metal, such as sodium, with liquid ammonia. As an alternative, the chemical warfare agent may be treated with an anhydrous (i.e., water-free) liquid ammonia. The product of the reaction may thereafter be oxidized with hydrogen peroxide. The ammonia is required to be pressurized/cooled to below its the boiling point. There is no suggestion that the ammonia should be in the form of a gas or that the hydrogen peroxide be in the form of a vapor. Indeed, the patent states that water should be avoided in the reaction stage (col. 11, lines 7-11).

Wagner discloses a decontamination composition for chemical warfare agents comprising a mixture of baking soda (sodium bicarbonate), hydrogen peroxide, and alcohol. There is no ammonia in Wagner's composition. The Wagner patent discloses that the mixture may be in the form of a spray, liquid, solid, or vapor. However, it is unclear how the bicarbonate in the composition could be in a vapor state.

Further, there is no motivation for combining Wagner with Abel since Abel requires the treatment to be performed in the absence of water, with the ammonia in a liquid state.

The Searcher also raised a combination of US 2003/045767 to Brown and DD 300 472. Brown discloses treating chemical and biological warfare agents using a solution generated from a combination of a peroxy compound and a bleach activator. These components form a percarboxylic acid prior to contacting the warfare agent with the solution. It is the percarboxylic acid which is considered to be the active agent. The solution is applied by spraying, showering, washing, or other suitable means (paragraph 29). There is no suggestion of treating the warfare agent with a nitrogen containing compound in the form of a gas or of forming a vapor of the solution.

DD 300 472 discloses a procedure for pressure-free bleaching of cellulose-containing natural products, such as branches, beech nuts, and the like for use as decoration accessories for fixed articles and grave decoration. These natural products are treated with 30% hydrogen peroxide and 25% ammonia as an activator. There is no suggestion that the hydrogen peroxide of DD 300 472 be in the form of a vapor and that the ammonia be in the form of a gas. Nor is there any suggestion that the composition of DD 300 472 be suited to the deactivation of chemical warfare agents. Further, there is no motivation for replacing the bleach activator of Brown with the ammonia of DD 300 472. Brown's object is to form a percarboxylic acid. Ammonia does not react with hydrogen peroxide to form a percarboxylic acid.

Accordingly, it is submitted that claim 1, and claims 2-27 dependent therefrom, meet the requirements for patentability.

An early indication that claims 1-27 are patentable is earnestly solicited.

Respectfully submitted,

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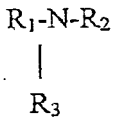
APPENDIX

Amendments to Claim 1

1. A method of deactivating a pathogenic chemical agent characterized by:

subjecting the pathogenic chemical agent to a peroxide in the form of a vapor and a nitrogen containing compound in the form of a gas, a ratio of the peroxide to the nitrogen containing compound being between 1:1 and 1:0.0001, the nitrogen containing compound being of the general formula:



where R_1, R_2, and R_3 independently are selected from H and an alkyl group.

On the other hand, G-agents, such as GD tend to be quite stable in the presence of hydrogen peroxide. GD does not undergo an autocatalytic perhydrolysis neutralizing reaction with hydrogen peroxide. Rather, G-type agents are typically deactivated with liquid hydrogen peroxide by base catalysis. Specifically, ammonia has been used to facilitate the base catalyzed hydrolysis of agents with liquid hydrogen peroxide, or perhydrolysis. Molybdate ions have also been used in combination with liquid hydrogen peroxide. The permolybdate ions formed have been found to deactivate G, V and H-agents.

The present application delivers a vapor phase deactivator which is effective against G, V, and H-type agents, as well as against biological agents.

Summary of the Invention

In accordance with one aspect of the present invention, a method of deactivating a pathogenic chemical agent is provided. The method includes subjecting the pathogenic chemical agent to a peroxide in the form of a vapor and a nitrogen containing compound in the form of a gas, a ratio of the peroxide to the nitrogen containing compound being between 1:1 and 1:0.0001. The nitrogen containing compound is of the general formula:

$$R_1\text{-}N(\text{-}R_3)\text{-}R_2$$

where R_1, R_2, and R_3 independently are selected from H and an alkyl group.

In accordance with another aspect of the present invention, an apparatus for deactivating a pathogenic chemical agent is provided. The apparatus includes a means for subjecting the pathogenic chemical agent to a mixture of a strong oxidant compound and an alkaline compound, both in a gaseous form.

In accordance with another aspect of the present invention, a method for decontamination of an item contaminated with GD. The method includes contacting the item in an enclosure with a vapor containing a peroxide and ammonia for sufficient time to reduce the concentration of GD to less than about 1% of

Having thus described the preferred embodiment, the invention is now claimed to be:

1. A method of deactivating a pathogenic chemical agent characterized by:

subjecting the pathogenic chemical agent to a peroxide in the form of a vapor and a nitrogen containing compound in the form of a gas, a ratio of the peroxide to the nitrogen containing compound being between 1:1 and 1:0.0001, the nitrogen containing compound being of the general formula:

$$R_1\text{-}N(\text{-}R_3)\text{-}R_2$$

where R_1, R_2, and R_3 independently are selected from H and an alkyl group.

2. The method as set forth in claim 1, further characterized by:

the peroxide including hydrogen peroxide.

3. The method as set forth in claim 1 or 2, further characterized by:

the peroxide being in the form of a vapor.

4. The method as set forth in claim 3, further characterized by:

vaporizing a liquid peroxide compound to form a peroxide vapor.

5. The method as set forth in claim 1, further characterized by:

the nitrogen containing compound including ammonia.

6. The method as set forth in claim 1, further characterized by:

the nitrogen containing compound including an alkyl amine.

7. The method as set forth in any one of claims 1-6, further characterized by:

the ammonia gas and the hydrogen peroxide vapor being present in a ratio of between 1:1 and 0.0001:1.0.

8. The method as set forth in any one of claims 1-7, further characterized by:

the nitrogen containing compound and peroxide being in the form of a gaseous mixture.

9. The method as set forth in claim 8, further characterized by:

the nitrogen containing compound being at a concentration of at least 1 ppm in the gaseous mixture.

10. The method as set forth in claim 9, further characterized by:

the nitrogen containing compound concentration being less than about 100 ppm.

11. The method as set forth in claim 10, further characterized by:

the nitrogen containing compound concentration being at least about 3 ppm in the gaseous mixture and less than about 20 ppm.

12. The method as set forth in claim 11, further characterized by:

the nitrogen containing compound including ammonia at a concentration of about 8 ppm.

13. The method as set forth in any one of claims 8-12, further characterized by:

the peroxide being at a concentration of at least 50 ppm in the gaseous mixture.

14. The method as set forth in any one of claims 8-13, further characterized by:

the peroxide being at a concentration of less than 1000 ppm in the gaseous mixture.

15. The method as set forth in claim 14, further characterized by:

the peroxide being at a concentration of at least 400-800 ppm in the gaseous mixture.

16. The method as set forth in claim 15, further characterized by:

the nitrogen containing compound including ammonia at a concentration of from about 3-20 ppm.

17. The method as set forth in claim 16, further characterized by:

the temperature being about 23-25°C.

18. The method as set forth in claim 16 or 17, further characterized by:

the peroxide including hydrogen peroxide at a concentration of about 600 ppm in the gaseous mixture.

19. The method as set forth in claim 18, further characterized by:

the nitrogen containing compound including ammonia at a concentration of about 8 ppm in the gaseous mixture.

20. The method as set forth in any one of claims 13-19, further characterized by:

the peroxide concentration being at least about 200 ppm in the gaseous mixture.

21. The method as set forth in any one of claims 8-20, further characterized by:

the gaseous mixture further including a carrier gas.

22. The method as set forth in claim 21, further characterized by:

the carrier gas including air.

23. The method as set forth in any one of claims 1-22, further characterized by:

the chemical agent including at least one of G-type, V-type, and H-type chemical agents, and combinations thereof.

24. The method as set forth in claim 23, further characterized by:

the chemical agent including a G-type chemical agent and the method including contacting the pathogenic chemical agent with the nitrogen containing compound and peroxide for sufficient time to reduce the G-type agent to a level of less than 1% of its original concentration.

25. The method as set forth in claim 23 or 24, further characterized by:

the contacting time being up to about six hours.

26. The method as set forth in any one of claims 1-25, further characterized by:

maintaining the temperature during the step of subjecting at from about 15°C to about 30°C.

27. The method as set forth in any one of claims 1-26, further characterized by:

the nitrogen containing compound being a liquid and the method further including vaporizing the liquid in a vaporizer.

28. An apparatus for deactivating a pathogenic chemical agent characterized by:

means (20, 32) for subjecting the pathogenic chemical agent to a mixture of a strong oxidant compound and an alkaline compound, both in a gaseous form.

29. The apparatus as set forth in claim 28, further characterized by:

the subjecting means including:

a vaporizer for vaporizing a peroxide liquid,

a supply (32) of a nitrogen-containing compound, and

a mixing region (30) for mixing the nitrogen containing compound and vapor.

30. The apparatus as set forth in claim 29 further characterized by:

means (24) for injecting hydrogen peroxide to the vaporizer at a rate of 0.4-0.5 grams/minute.

31. The apparatus as set forth in claim 29 or 30, further characterized by:

the mixing region being at the entrance of an enclosure (10) in which the pathogenic chemical agent is disposed.

32. The apparatus as set forth in claim 31, further characterized by:

a liquid hydrogen peroxide source for supplying liquid hydrogen peroxide to the vaporizer, and

the supply (32) of nitrogen containing compound including a compressed ammonia gas tank.

33. The apparatus as set forth in claim 32, further characterized by:

a control means (24, 34) which controls a rate of supplying the hydrogen peroxide to the vaporizer and a rate of supplying the ammonia gas to achieve a peroxide vapor to ammonia vapor ratio between 1:1 and 1:0.0001.

34. The apparatus as set forth in claim 32 or 33, further characterized by:

a control means (24, 34) which controls a rate of supplying the hydrogen peroxide to the vaporizer and a rate of supplying the ammonia gas to form a mixture in which a concentration of ammonia is at least 1ppm.

35. The apparatus as set forth in any one of claims 28-34, further characterized by:

the nitrogen containing compound including a liquid, and further characterized by:

a mister (30) for forming a mist of the liquid nitrogen containing compound.

36. The apparatus as set forth in any one of claims 28-35, further characterized by:

a chamber (10) connected with the mixing region for receiving items contaminated with the pathogenic chemical agent.

37. The apparatus as set forth in any one of claims 28-36, further characterized by:

the subjecting means including:

a means (50) for atomizing or vaporizing an alkaline liquid to form the nitrogen containing compound.

38. The apparatus as set forth in claim 37, further characterized by:

a peroxide vaporizing means (20) which generates a vapor or mist containing the peroxide; and

a chamber (10) connected with the atomizing or vaporizing means for receiving the vapor or mist.

39. A method for decontamination of an item contaminated with GD, the method characterized by:

contacting the item in an enclosure (10) with a vapor containing a peroxide and ammonia for sufficient time to reduce the concentration of GD to less than about 1% of its initial concentration, the time for the concentration to reach 1% of its initial concentration being less than 6 hrs.

40. A method of deactivating a pathogenic chemical agent characterized by:

forming a peroxide vapor;

increasing the pH of the vapor with a pH-increasing compound;

subjecting the pathogenic chemical agent to the peroxide at the increased pH for sufficient time to deactivate the chemical agent.

41. The method as set forth in claim 40, further characterized by the peroxide including hydrogen peroxide and the pH-increasing compound includes ammonia.

42. The method as set forth in claim 41, further characterized by the hydrogen peroxide being at a concentration of from about 200-800 ppm and the ammonia is at a concentration of from 3-40 ppm.

43. The method as set forth in claim 42, further characterized by the temperature being at room temperature.

44. A method of deactivating a biologically active substance characterized by:

subjecting the biologically active substance to a mixture of a strong oxidant compound and an alkaline compound, both in a gaseous form.

45. The method as set forth in claim 44, further characterized by:

the alkaline compound in gaseous form including a mist formed by atomizing a liquid alkaline compound.

46. The method as set forth in claim 44 or 45, further characterized by:

the strong oxidant including a peroxy compound.

47. The method as set forth in claim 46, further characterized by:

vaporizing a liquid peroxy compound to form a peroxy vapor.

48. The method as set forth in any one of claims 44-47, further characterized by:

the alkaline compound including at least one of ammonia and a short chain alkyl amine.

49. The method as set forth in any one of claims 44-48, further characterized by:

the peroxy compound including hydrogen peroxide.

50. The method as set forth in any one of claims 44-49, further characterized by:

the biologically active substance including one or more of chemical agents, pathogens, prions, and biotoxins.

51. The method as set forth in claim 50, further characterized by:

the biologically active substance including G-type nerve agents.

52. The method as set forth in claim 50, further characterized by:

the ammonia gas and the hydrogen peroxide vapor being present in a ratio of between 1:1 and 0.0001:1.0.